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US005197420A

**United States Patent** [19]

Arnold et al.

[11] **Patent Number:** 5,197,420[45] **Date of Patent:** Mar. 30, 1993[54] **CAMSHAFT ADJUSTER AND TENSIONER**

[75] **Inventors:** Gerd Arnold, Nauheim; Markus Lienkamp, Bad Schwalbach; Albert Schwelkard, Appenheim, all of Fed. Rep. of Germany

[73] **Assignee:** General Motors Corporation, Detroit, Mich.

[21] **Appl. No.:** 808,514

[22] **Filed:** Dec. 16, 1991

[30] **Foreign Application Priority Data**

Dec. 24, 1990 [DE] Fed. Rep. of Germany ..... 4041785

[51] **Int. Cl.:** ..... F01L 1/34; F01L 1/04

[52] **U.S. Cl.:** ..... 123/90.15; 123/90.31; 474/110; 474/111

[58] **Field of Search:** ..... 123/90.15, 90.17, 90.31; 474/110, 111, 117, 138

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*Primary Examiner*—E. Rollins Cross

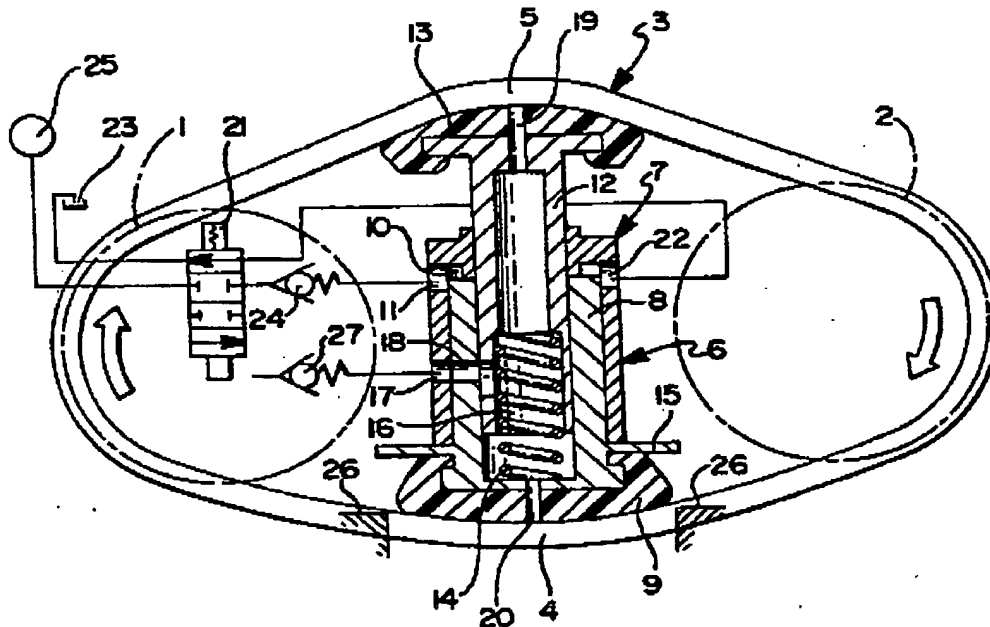
*Assistant Examiner*—Weilun Lo

*Attorney, Agent, or Firm*—Robert J. Outland

[57] **ABSTRACT**

A camshaft adjuster mounted between a taut strand and a slack strand of a chain connecting an intake camshaft to an exhaust camshaft has two tensioning shoes which are urged by a spring away from each other and against the inner sides of the chain strands. One tensioning shoe is mounted on a reciprocable piston within which a plunger carrying the other tensioning shoe is slidable against the force of the spring. The piston is moved against the taut strand by pressurization of a pressure chamber through a nonreturn valve and the plunger is moved with the piston so that the taut and slack strands are moved together and compression of the tensioning spring is thereby maintained relatively constant. A damping chamber may be provided with throttling bores in the piston and/or plunger to control the damping effect.

8 Claims, 1 Drawing Sheet





US006363896B1

(12) **United States Patent**  
Speier

(10) Patent No.: **US 6,363,896 B1**  
(45) Date of Patent: **Apr. 2, 2002**

(54) **CAMSHAFT ADJUSTER FOR INTERNAL COMBUSTION ENGINES**

(75) Inventor: **Wolfgang Speier, Stuttgart (DE)**

(73) Assignee: **DaimlerChrysler AG, Stuttgart (DE)**

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/673,772**

(22) PCT Filed: **Apr. 14, 1999**

(86) PCT No.: **PCT/EP99/02495**

§ 371 Date: **Jul. 5, 2001**

§ 102(e) Date: **Jul. 5, 2001**

(87) PCT Pub. No.: **WO99/54599**

PCT Pub. Date: **Oct. 28, 1999**

(30) **Foreign Application Priority Data**

Apr. 18, 1998 (DE) ..... 198 17 319

(51) Int. Cl.<sup>7</sup> ..... **F01L 1/344**

(52) U.S. Cl. .... **123/90.17; 74/568 R**

(58) Field of Search ..... **123/90.15, 90.17, 123/90.31; 74/568 R; 464/1, 2, 160**

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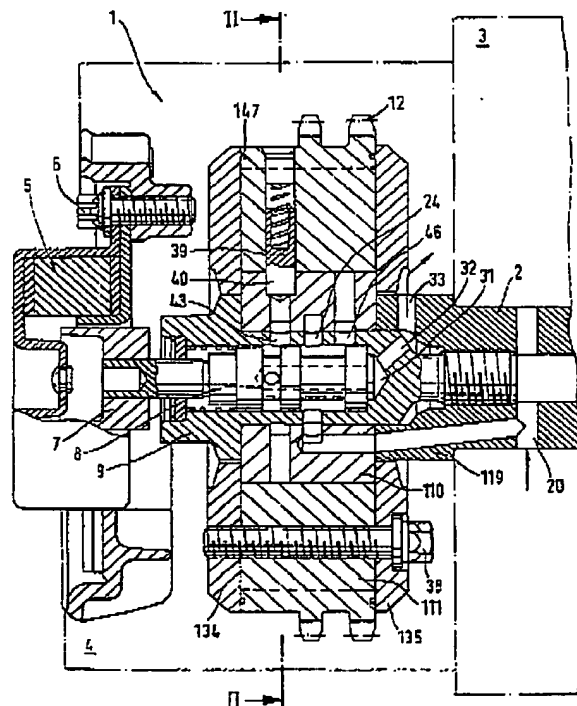
*Primary Examiner—Weilun Lo*

(74) Attorney, Agent, or Firm—**Kenyon & Kenyon**

(57) **ABSTRACT**

A camshaft adjuster (1) for internal combustion engines has a central tensioning screw (9) for fixing the adjuster (1) in relation to a camshaft (2). A slide (8) controls the supply of the pressure medium to the camshaft adjuster (1) being integrated into the tensioning screw (9). The tensioning screw (9) forms the mounting of the camshaft adjuster (1) in relation to the camshaft (2).

**4 Claims, 3 Drawing Sheets**





US006675752B1

(12) **United States Patent**  
Kunne et al.

(10) Patent No.: **US 6,675,752 B1**  
(45) Date of Patent: **Jan. 13, 2004**

(54) **INTERNAL COMBUSTION ENGINE WITH  
HYDRAULIC CAMSHAFT ADJUSTER FOR  
ADJUSTING THE CAMSHAFT**

(75) Inventors: Ernst-Andreas Kunne, Schwillper  
(DE); Andreas Knecht, Kusterdingen  
(DE)

(73) Assignee: Volkswagen AG, Wolfsburg (DE)

(\*) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 0 days.

(21) Appl. No.: 10/088,453

(22) PCT Filed: Sep. 12, 2000

(86) PCT No.: PCT/EP00/08904

§ 371 (c)(1),  
(2), (4) Date: Mar. 13, 2002

(87) PCT Pub. No.: WO01/20135

PCT Pub. Date: Mar. 22, 2001

(30) **Foreign Application Priority Data**

Sep. 13, 1999 (DE) ..... 199 43 833

(51) Int. Cl.<sup>7</sup> ..... F01L 1/34

(52) U.S. Cl. .... 123/90.17; 123/90.15;  
123/90.16; 123/90.27; 464/160

(58) Field of Search .... 123/90.15, 90.16,  
123/90.17, 90.18, 90.27, 90.31, 90.34; 464/1,  
2, 160

(56) **References Cited**

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Primary Examiner—Thomas Denion

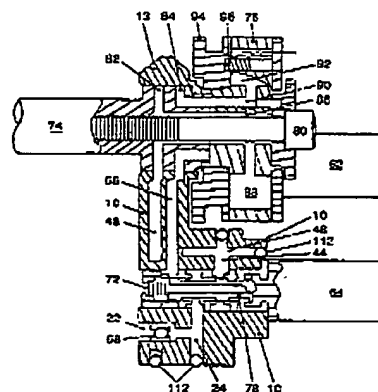
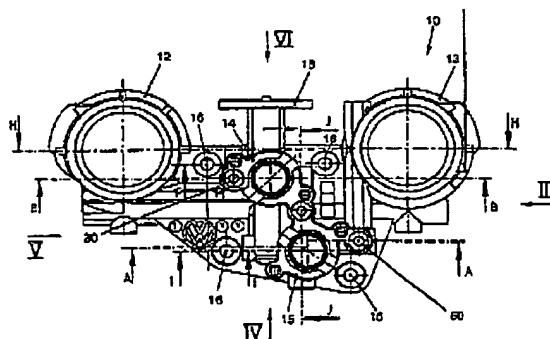
Assistant Examiner—Ching Chang

(74) Attorney, Agent, or Firm—Ostroleak, Faber, Gerb &  
Soffen, LLP

(57) **ABSTRACT**

An internal combustion engine including a cylinder head having gas-exchange valves, at least one camshaft supported on the cylinder head, which camshaft is driven by a crankshaft to actuate corresponding gas-exchange valves on the cylinder head, and a camshaft adjuster arranged on the camshaft. The adjuster has a hydraulic pressure chamber and is configured to use hydraulic pressure to rotate position of the camshaft relative to the crankshaft to change control times of the gas-exchange valves. A feed device for hydraulic pressure is provided on the camshaft adjuster and is configured as a component separate from the cylinder head. The feed device has a ring for each camshaft, each ring having two grooves, each of the grooves being connected via associated hydraulic pressure channels in the feed device to a hydraulic pressure valve. Each ring is arranged to surround a section of the camshaft. Each surrounded section of the camshaft has two ring-shaped grooves, each of which is aligned with one of the grooves of the corresponding ring to form a pair. Each groove/ring-shaped groove pair of a ring is connected via associated hydraulic pressure channels in the camshaft to the hydraulic pressure chamber of the camshaft adjuster mounted on the camshaft.

5 Claims, 16 Drawing Sheets



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Cabriolet  
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GT2

# Engine and Transmission

## Engine diagram

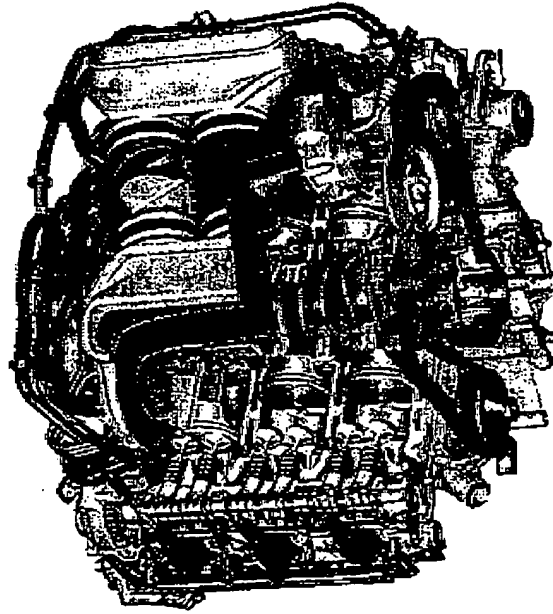


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Engine: 911 Carrera S

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### Legend 1



### Features and Specifications

#### Highlights

Engine and Transmission  
Chassis  
Safety and Security  
Comfort  
Personalization  
Colors  
Equipment  
Technical specifications  
European Delivery  
Photo Gallery

- 1 Oil scavenger pump
- 2 Camshaft adjuster (VarioCam Plus)
- 3 Control valve for camshaft adjuster
- 4 Control valve for variable valve lift
- 5 Switchable tappets with hydraulic valve clearance adjustment
- 6 Inlet camshaft
- 7 Pre-separator
- 8 Crankcase ventilation pipe
- 9 Oil feed pump
- 10 Tandem pump
- 11 Resonance valve
- 12 Plenum duct
- 13 Plenum chamber with integrated resonator
- 14 Resonator
- 15 Throttle-valve tract



US006390043B1

(12) **United States Patent**  
Niethammer et al.

(10) **Patent No.:** US 6,390,043 B1  
(45) **Date of Patent:** May 21, 2002

(54) **DEVICE FOR HYDRAULICALLY  
ADJUSTING THE ANGLE OF ROTATION OF  
A SHAFT IN RELATION TO A DRIVING  
WHEEL**

5,215,046 A 6/1993 Obata et al. .... 123/90.17  
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(75) **Inventors:** Bernd Niethammer, Nürtingen;  
Andreas Knecht, Ammerbuch, both of  
(DE)

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(73) **Assignee:** Dr. Ing.H.C.F. Porsche AG, Weissach  
(DE)

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EP	0 652 354	5/1995
JP	59-229011	12/1984

(\*) **Notice:** Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 0 days.

\* cited by examiner

(21) **Appl. No.:** 09/674,707

*Primary Examiner*—Wellun Lo

(22) **PCT Filed:** Apr. 14, 1999

(74) *Attorney, Agent, or Firm*—Crowell & Moring LLP

(86) **PCT No.:** PCI/EP99/02504

#### (57) ABSTRACT

§ 371 Date: Jan. 26, 2001

§ 102(e) Date: Jan. 26, 2001

(87) **PCT Pub. No.:** WO99/57423

PCT Pub. Date: Nov. 11, 1999

(30) **Foreign Application Priority Data**

May 5, 1998 (DE) ..... 198 19 995

(51) **Int. Cl.<sup>7</sup>** ..... F01L 1/344

(52) **U.S. Cl.** ..... 123/90.17; 74/568 R

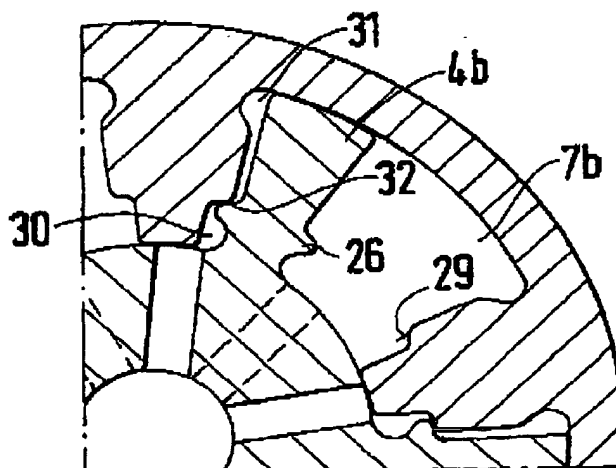
(58) **Field of Search** ..... 123/90.15, 90.17,  
123/90.31; 74/568 R; 464/1, 2, 160

(56) **References Cited**

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4,858,572 A 8/1989 Shirai ..... 123/90.12

5 Claims, 3 Drawing Sheets





US006209497B1

(12) **United States Patent**  
Niethammer et al.

(10) Patent No.: **US 6,209,497 B1**  
(45) Date of Patent: **Apr. 3, 2001**

(54) **DEVICE FOR CHANGING THE RELATIVE ROTATIONAL POSITION OF A SHAFT TO THE DRIVE WHEEL**

(75) Inventors: Bernd Niethammer, Nuertingen;  
Andreas Knecht, Amtnbuch, both of (DE)

(73) Assignees: Dr. Ing. h.c.F. Porsche Aktiengesellschaft, Stuttgart;  
Hydraulik Ring GmbH, Nuertingen, both of (DE)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/463,447

(22) PCT Filed: Apr. 14, 1999

(86) PCT No.: PCT/EP99/02505

§ 371 Date: Apr. 4, 2000

§ 102(e) Date: Apr. 4, 2000

(87) PCT Pub. No.: WO99/61759

PCT Pub. Date: Dec. 2, 1999

(30) Foreign Application Priority Data

May 27, 1998 (DE) ..... 198 23 619

(51) Int. Cl.<sup>7</sup> ..... F01L 1/344

(52) U.S. Cl. .... 123/90.17; 123/90.31;  
74/568 R; 464/2; 464/160

(58) Field of Search ..... 123/90.15, 90.17,  
123/90.31; 74/568 R; 464/1, 2, 160

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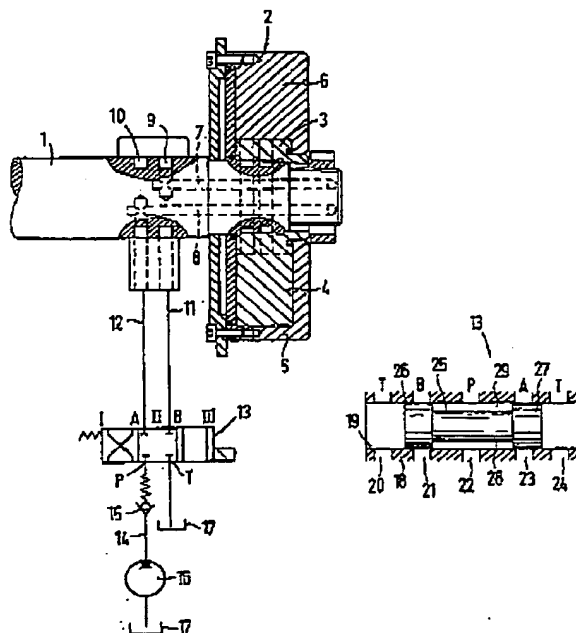
Primary Examiner—Weilun Lo

(74) Attorney, Agent, or Firm—Evenson, McKeown,  
Edwards & Lenahan, P.L.L.C.

(57) **ABSTRACT**

The system according to the invention for the relative rotating position change of a shaft with respect to a driving wheel has an adjusting device with two pressure spaces which act against one another and which can be acted upon by a pressure medium pump. In order to achieve a uniform controlled adjusting operation and a secure position fixing, the pressure space connected with the pressure medium pump is acted upon by pressure at the start of the adjusting movement before the opposite pressure space connected with the pressure medium tank is relieved.

15 Claims, 1 Drawing Sheet





US006129063A

**United States Patent** [19]  
**Niethammer et al.**

[11] **Patent Number:** **6,129,063**[45] **Date of Patent:** **Oct. 10, 2000**

[54] **DEVICE FOR CHANGING THE  
 ROTATIONAL POSITION OF A SHAFT  
 RELATIVE TO A DRIVE WHEEL AND  
 METHOD OF MAKING SAME**

5,937,810 8/1999 Sato et al. 123/90.17

**FOREIGN PATENT DOCUMENTS**

0781899A1 7/1997 European Pat. Off.  
 197 45 908 4/1999 Germany

[75] **Inventors:** Bernd Niethammer, Nuertingen;  
 Andreas Knecht, Ammerbuch, both of  
 Germany

[73] **Assignee:** Dr. Ing. h.c.F. Porsche AG, Weissach,  
 Germany

*Primary Examiner*—Weilun Lo  
*Attorney, Agent, or Firm*—Evenson, McKeown, Edwards &  
 Lenahan, P.L.L.C.

[21] **Appl. No.:** 09/359,433[22] **Filed:** Jul. 22, 1999[30] **Foreign Application Priority Data**

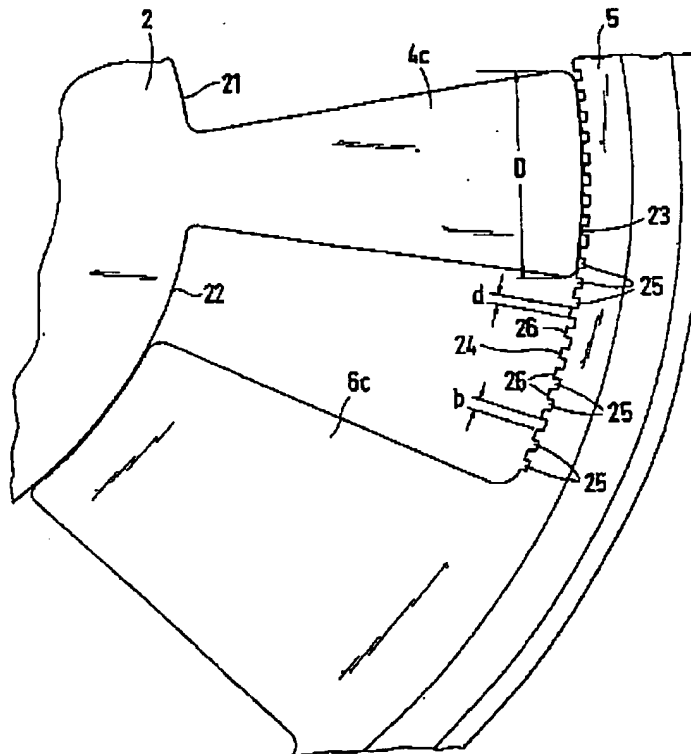
Aug. 1, 1998 [DE] Germany 198 34 843

[51] **Int. Cl.** F01L 1/344[52] **U.S. Cl.** 123/90.17; 123/90.31;  
 74/568 R; 464/2[58] **Field of Search** 123/90.15, 90.17,  
 123/90.31; 74/568 R; 464/1, 2, 160[56] **References Cited****U.S. PATENT DOCUMENTS**

5,836,276 11/1998 Iwasaki et al. 123/90.17

[57] **ABSTRACT**

A device for changing the rotational position of a shaft relative to a drive wheel has an adjusting device with two pressure chambers that act against one another. The chambers are pressurized by a pressure medium pump. The adjusting device includes an inner part with ribs that divides the chambers formed by the ribs of a compartmented wheel into corresponding pressure chambers. A plurality of depressions extending axially are machined into the circumferential surfaces of the compartmented wheel that faces the ribs of the inner part, which depressions serve to collect dirt particles carried by the pressure medium into the pressure chambers.

**22 Claims, 3 Drawing Sheets**



US006053138A

**United States Patent** [19]

Trzmiel et al.

[11] **Patent Number:** 6,053,138[45] **Date of Patent:** Apr. 25, 2000

[54] **DEVICE FOR HYDRAULIC ROTATIONAL ANGLE ADJUSTMENT OF A SHAFT RELATIVE TO A DRIVE WHEEL**

[75] **Inventors:** Alfred Trzmiel, Grafenberg, Wolfgang Stephan, Boll; Axel-Wilhi Jochim, Nuertingen, all of Germany

[73] **Assignees:** Hydraulik Ring GmbH; Dr. Ing. h.c.F. Porsche AG, both of Germany

[21] **Appl. No.:** 09/213,758

[22] **Filed:** Dec. 17, 1998

[30] **Foreign Application Priority Data**

Dec. 17, 1997 [DE] Germany ..... 197 56 015

[51] **Int. Cl.<sup>7</sup>** ..... F01L 1/344

[52] **U.S. Cl.** ..... 123/90.17; 123/90.31; 74/568 R; 464/2

[58] **Field of Search** ..... 123/90.12, 90.15, 123/90.17, 90.31; 74/568 R; 464/1, 2, 160

[56] **References Cited**

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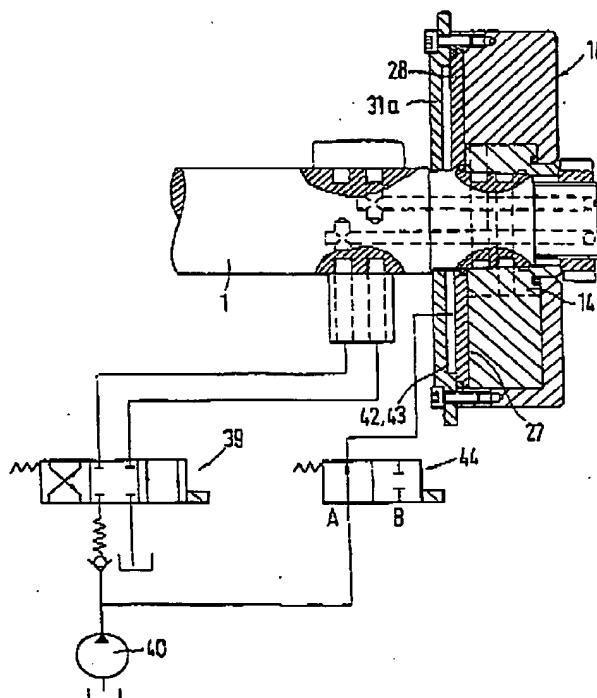
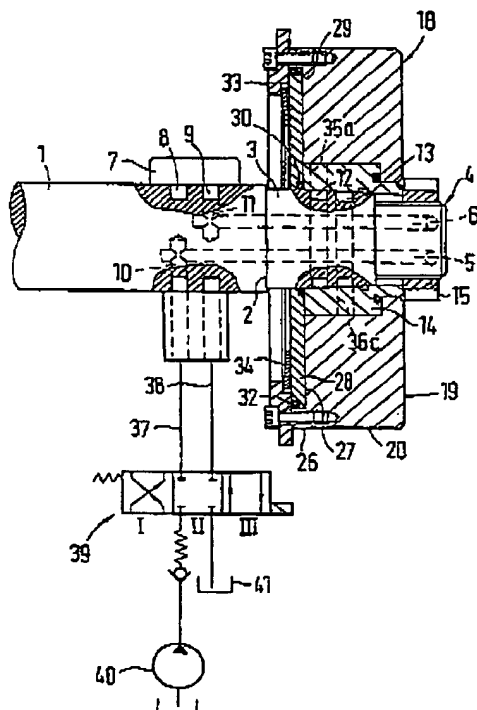
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2302391 1/1997 United Kingdom .  
2314402 12/1997 United Kingdom .

*Primary Examiner*—Wellun Lo  
*Attorney, Agent, or Firm*—Evenson, McKeown, Edwards & Lenahan, P.L.L.C.

[57] **ABSTRACT**

A device for hydraulic rotational angle adjustment of a shaft to a drive wheel, especially the camshaft of an internal combustion engine, has ribs or vanes that are nonrotatably connected with the shaft, said ribs or vanes being located in the compartments of a compartmented wheel. The compartments of the compartmented wheel and the ribs and/or vanes produce pressure chambers by whose hydraulic pressurization the two structural elements can be rotated relative to one another. In order to secure the two structural elements against undesired rotation when an insufficient adjusting or retaining pressure is present, a common end face of the compartmented wheel and of the ribs and/or vanes cooperates with an annular piston that exerts a releasable clamping action on the parts that are rotatable relative to one another.

20 Claims, 3 Drawing Sheets





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- ☐ Heat Loss & Insulation

- ☐ Pressure Ratings
- ☐ Temperature Expansion
- ☐ Valve Standards

## Valves - Types

### Classifications of valves

Categories of Valves	Application Description
Flow regulating valves	For controlling rate of flow.
Temperature regulating valves	For controlling fluid temperature in a system.
Automatic process control valves	For controlling rate of flow relative to value.
Anti vacuum valves	An automatic type of air valve preventing the formation of vacuum in tanks or pipelines.
Blow down valves	A valve which is used for cleaning sludge from a boiler.
Bulkhead valves	A gate valve.
Free ball valves	A valve in which a ball is free to rotate in any direction.
Fusible link or fire valves	A fire prevention valve which has a weighted lever hold open by a wire and fusible link which melts at an

	increase of room temperature.
Hydraulic valves	A control valve for water, oil, or hydraulic systems.
Jet dispersal valve	A valve incorporating an element by virtue of which the energy within the emitting jet is dissipated.
Penstock	A single faced type of valve consisting of an open frame and a door and used in terminal positions only. Normal located in tanks or channels for controlling flow in to a pipe.
Plate valves	A gate valve incorporating a sluicing effect.
Radiator valves	A valve controlling the flow of water through a radiator.
Rotary slide valve	A valve in which a rotation of internal parts regulates flow by opening or closing a series of segmental ports.
Rotary valve	A spherical plug valve in which the plug, which rotates through 90°.
Solenoid valve	A valve operated by an electrical solenoid.
Spectacle eye valve	A parallel slide valve.
Thermostatic mixing valve	A valve which combines temperature.
Throttle valve	A non tight closing butterfly valve.

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piston pin  
piston ring  
piston rod

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**Main Entry: pis-ton** 1)

**Pronunciation:** 'pis-tən

**Function:** *noun*

**Etymology:** French, from Italian *pistone*, from *pistare* to pound, from Old Italian, from Medieval Latin, from Latin *pistus*, past participle of *pinserē* to crush -- more at **PESTLE**  
**1** : a sliding piece moved by or moving against fluid pressure which usually consists of a short cylinder fitting within a cylindrical vessel along which it moves back and forth

**2 a** : a sliding valve moving in a cylinder in a brass instrument which when depressed by a finger knob serves to lower the instrument's pitch **b** : a button on an organ console to bring in a previously selected registration

For More Information on "piston" go to [Britannica.com](http://Britannica.com)

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